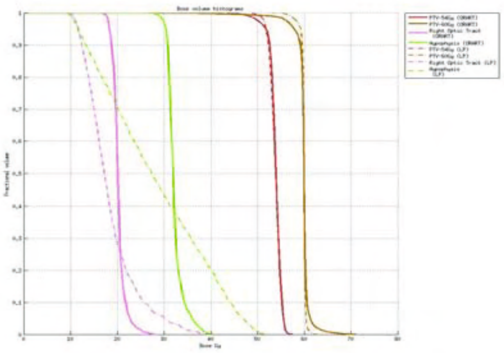
26.5.for hypophysis. For PTV54 and PTV60 we found 51.5 and 58.9 gEUD values with LP based initial point, compared to 51.7 and 57.9.
Conclusions: The results indicate that the approach of using linear programming is an effective way to easily obtain a good plan and to improve gEUD based optimization.



PO-0835
Ultra-fast arc therapy planning framework
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Purpose/Objective: We introduce an ultra-fast optimization framework for arc therapy and highlight the potential of non-coplanar arcs.
Materials and Methods: The implementation of the arc therapy planning is based on [Bzdusek et al. MedPhys 2009]. First, an IMRT fluence optimization (FO) using 24 equi-spaced coplanar beam orientations is performed and the resulting fluence profiles are sequenced. From every IMRT beam orientation, three shapes are selected according to the dose area product and distributed to 72 equi-spaced coplanar beam orientations used for arc therapy optimization. The initial shapes are refined using a gradient based direct aperture optimization (DAO) algorithm. Both FO and DAO are performed at 2.62 x 2.62 x 2.62 mm³ voxel and 5 x 5 mm² bixel resolutions. During inverse planning, we use an ultra-fast dose, gradient, and objective function calculation engine which was originally developed for a beam angle selection algorithm to accelerate the optimization process.
As a first application we use our framework to compare three different plans:
1. Coplanar arc therapy plans
2. IMRT plans with 9 beams, non coplanar, beam angle optimized
3. 4 π plans, not sequenced
The 4 π plan is an IMRT plan with up to 1400 beam orientations using every practicable direction. An intra cranial, a pancreas, and a prostate case are examined for each type of plan.
The framework is tested on an AMD Opteron workstation (4 CPUs, 1.9 MHz, 128 GB RAM, US$ 5000).
Results: We observe runtimes of less than 25 s for an arc therapy optimization excluding the initial calculation of the dose influence data (see table 1).

Case	Size of data	Iterations (IMRT)	Iterations (DAO)	Time
Intra cranial	1.13 GB	21	30	6.9 s
Pancreas	3.92 GB	21	53	23.8 s
Prostate	3.49 GB	21	70	24.5 s

Table 1: Optimization parameters for arc therapy plans.

For the intra cranial case (DVHs in figure 1) the target conformality of the arc plan is comparable to the 4 π plan (van't Riet's conformality numbers of 0.86 and 0.9). The target conformality of the non coplanar plan applying 9 optimized beam orientations is significantly decreased (0.72).

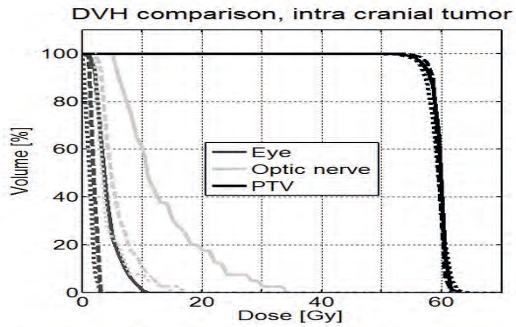

Figure 1: Arc plan, 72 beams, coplanar (line); IMRT plan, 9 beams, non coplanar, sequenced (dotted); IMRT plan, 1376 beams, 4 pi (dashed)

Using non coplanar beams, however, it was possible to spare the organs at risk (OARs) in a better way than with the coplanar arc plan. For the nine beam IMRT plan, the mean (max) dose of the left eye can be reduced from 4.1 Gy (10.7 Gy) to 1.2 Gy (2.8 Gy). Also the left optical nerve receives only 4.4 Gy (17.0 Gy) instead of 13.3 Gy (34.2 Gy).
For the less complex pancreas case we observe similar but weaker effects regarding the improvement of OAR sparing than for the intra cranial case. The different plans of the prostate case show only slight differences.
Conclusions: We demonstrated that it is possible to optimize arc therapy plans in less than 30 s. Our preliminary treatment plan comparison indicates that for complex geometries, non coplanar beams may enable superior OAR sparing than a conventional coplanar arc plan. Hence, we want to use the developed ultra-fast arc therapy optimization framework to study the benefit of non coplanar arc therapy in future investigations.

PO-0836
Stochastic frontier method for IMRT planning optimisation based on geometry
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Purpose/Objective: Ideally, Intensity modulated radiation therapy (IMRT) should allow the conception of treatment plans with equivalent curative outcomes and better normal tissue sparing than those obtained with traditional techniques. It is however always necessary to make some compromises between PTV coverage and OAR sparing. Such compromises are often dependent on the person preparing the plan. To accelerate, standardize and increase efficiency of future planning, we aim to determine some criterions based on patient specific geometry by using parameters such as the distances between targets and OAR and the amount of overlap between them. These parameters were adjusted by doing a retrospective study of head and neck IMRT plans.
Materials and Methods: Maximum and mean dose to some OARs were put in relationship with distance between OAR and PTVs, overlap volume and overlap gradient on the first centimeter of PTV. Here, only the lower bound is of interest to attempt to predict the lower dose reachable as a function of the geometry. Stochastic frontier production method, as used in economics, was adapted to model the frontier, i.e. the lowest achievable dose to OAR. This method assumes a mix of deterministic and stochastic distributions of OAR doses, near an optimal frontier. Maximum likelihood is used to extract the frontier function, dependent on the relevant geometric parameters.
Results: Eighty patient cases were analyzed with this approach and a good relation was obtained between the overlapping volume and the mean dose of the parotid. Some adjustments must be applied when overlap with higher dose level of PTV is present to get a more precise frontier. The method is now currently extended to other OARs like larynx and to other sites like pelvis.
Conclusions: Frontier analysis showed promising potential. More than one parameter can be included to get a more precise frontier that lead to a more optimal plan. Also this approach can reduce the planning time. In future work we will introduce these criteria to our dosimetrists and evaluate possible gains in efficiency.

PO-0837
PTV spells paranoid target volume
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